6

INDUCED LIGHTNING STROKES

S. D. CHATTERJEE AND B. K. DUTTA

DEPARTMENT OF PHYSICS, JADAVPUR UNIVERSITY, CALCUTTA-32

(*Received, March* 11, 1960)

The mechanism of direct cloud-to-ground lightning strokes have been extensively studied by Schonland (1950), McEachron (1939) and others from photographs taken with modified Boys camera. The surges of direct lightning strokes to the power and telephone lines, and induced effects due to charge induced on the line by an overhead thundercloud have also been subjected to careful analysis by Peek (1924). And yet direct photographic evidences of induced lightning strokes are rare.

During the monsoon season at Calcutta, two interesting still shots of induced lightning strokes were taken from the same spot on two consecutive evenings. It appears that the local terrain produces great localised variations in storm and lightning-stroke density.

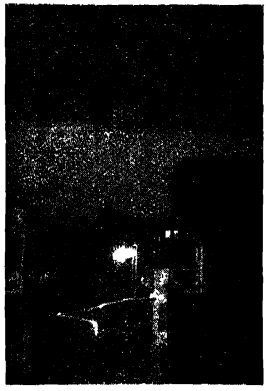

Fig. 1 : Two cloud-to-ground direct lightning strokes accompanied by a fencing post-to-ground induced lightning stroke. Sprouting positive streamers on the ground.

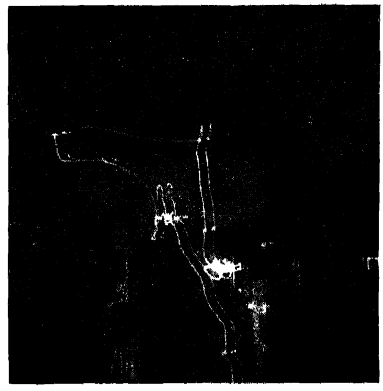

Fig. 2 · Induced double lightning stroke from two incandescent lamps mounted on lamp posts to the ground. Faintly luminous tracks of an earlier double flash over in the background. Zig-zag "St. Elmo's fire" from a receiving aerial on the roof of a double storeyed building on the right.

Fig. 1 depicts two cloud-to-ground direct strokes accompanied by an induced stroke which links a barbed-wire-fencing post with the ground. The high luminosity of the latter suggests that it is probably a return stroke which follows the junction of a stepped leader with a positive streamer coming from the ground. Some faint points of luminiscence on the ground in the neighbourhood of the flash may be other sprouting positive streamers which failed to connect with the leader.

Fig. 2 shows a tantalizing photograph, which was taken on the second evening amidst a crescendo of lightning flashes and peels of thunder, occurring within a couple of hundred feet of the camera. It seems that a violent, swiftly oncoming storm, unaccompanied by rain, induced a heavy charge density upon the ground surface. As the magnitude of the ground gradient rapidly increased, the accumulated electric stress between the ground and two street lamps caused almost simultaneously a double flash-over. The electric lamps were mounted on two eighteen feet high steel posts carrying overhead supply lines and were situated at a distance of ninety feet from each other. An earlier double flash-over between the ground and two other incandescent electric lamps protruding from the walls of a building is revealed by a faintly luminous double streak in the background. Presumably the earlier flash-over had taken place within 0.5 second before the opening of the camera shutter. Malan and Collens (1938) have reported data on luminiscence of heavy discharges whose duration ranges in extreme cases from a few hundred microseconds to half a second. Although the electrostatic lines of force from the origin of the stroke to the ground should form essentially smooth curves, the picture shows tortuous paths interspersed with loops. These may be attributed to some variable condition at the head of the discharge, this condition being either variations in the head itself or variations in space ionization. However, the strict parallelism of the two sets of double strokes indicate preponderance of the latter factor. It is indeed amazing that even the corona or "St. Elmo's fire" emanating from a receiving aerial on the roof of a right-hand-side building exhibits an analogous zig zag pattern.

Assuming 5000 volts per cm as a fairly acceptable value (Creighton, 1937) for the average gradient at the surface of the earth for spark-over between two sharp points, the maximum induced potential on each of the street lamps should be about two million volts, while that on the verandah lamps about half of this value. Nevertheless, the length of the individual luminous paths indicates that the induced voltage is of the order of 12 million volts.

REFERENCES

Creighton, E. E. F., 1937, A.I.E.E. Lightning reference book, 106.
Malan, D. J. and Collens, E. E. F., 1938, *Proc. Roy. Soc.*, A. **164**, 132.
McEachron, K. B., 1939, *Jour. Frank. Inst.*, **227**.
Peek Jr. F. W., 1924, *Transactions A.I.E.E.*, **43**, 1205.
Schonland, B. F. G., 1950, "The flight of thunderbolts", Clarendon Press, Oxford.